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ABSTRACT

Although Fred Keller's personalized system of instruction (PSI) has had a surprisingly rapid adoption in colleges and universities since its introduction in 1964, sound evaluation techniques for the method are still needed. Verbal reports are vague, while other methods that have been used are idiosyncratic and depend on the way the teacher presents the course. Oral interviews and self-pacing studies have other flaws. Much of the research to date has been sloppy, and many procedures have been introduced with only the flimsiest bit of empirical justification. Since a primary aim of PSI is to stimulate interest in the course, some dependent variables with measure interest might be studied. These might include the number and pattern of withdrawals in the course, a question-asking profile, or use of an interest library consisting of articles related to lectures which are stocked in student dormitories. Also, a self-management project might supplant traditional rat experiments in psychology courses. (JK)

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Personalized Systems of Instruction: How Evaluate?

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Most often complaints about the adoption of an educational innovation are that the adoption is too slow. In a recent article in Science, Lawrence Grayson states,

> "Education requires long lead times to turn innovation into widespread practice. In the 1930's, it was estimated that 57 years would be required to diffuse an innovation throughout the school system, even after the materials and methods had been thoroughly developed" (1972, p. 1219).

He goes on to say that by 1946, the lead time had decreased to 25 years but even this can hardly be characterized as rapid change. This time scale does not seem to apply to the educational innovation introduced by Fred Keller, called a Personalized System of Instruction (PSI). PSI has been growing at an incredible rate.

Since PSI's early trials at the University of Brasilia in 1964 and at Arizona State University in 1965 to the present is only 7 or 8 years. McMichael (1971) surveyed all of the four year institutions in the U.S. that had at least three department members listed in the APA directory and asked them if they were using PSI in any of their courses. Of those returning the questionnaire, 138 schools (31%) indicated that they were using PSI in at least one course. He also found another 23 institutions that were using PSI in departments other than psychology and in which the psychology department was not using it. Taken together, about 37% of the 440 colleges and universities surveyed had at least one department using PSI techniques. This is an average adoption rate of between 23 and 27 institutions a year which, I'm sure you'll agree, is remarkable.

Other evidence of widespread acceptance is that a Newsletter consisting of information about PSI courses, workshops, and new adoptions has already been put out. There was 400 requests for the Newsletter even before the first issue was released in June, of 1971, and the mailing list for the Newsletter has now

jumped to 1000 (PSI Newsletter, January, 1972). Such interest and ready acceptance indicates that most teachers already know that there is a great deal wrong with traditional educational practice, and that they are eager to try a promising new method.

But whatever the reasons for this willingness to adopt PSI by college teachers, I wish to inject a caution. Perhaps the adoption has been too fast. I am not alone in this concern - Ben Green at MIT is also worried about the speed with which PSI has been catching on (Green, 1971a). Why? Well, there is a real danger that without sound evaluative research, PSI will go the way of so many other attempts to renovate education. Widespread acceptance of a technique without sound evidence for that technique is just the formula for producing another "educational fad." Recent newspaper reports have told the story of how the Office of Education has become disenchanted with "performance contracting" by private companies as a means of helping the educationally disadvantaged get "caught up " (Salt Lake Tribune, April 30, 1972). PSI or bastardizations of it may be tried and dropped because of an incomplete understanding of the variables contributing to its efficacy. My purpose, then, is to point out what I believe to be some problems with the current research; to discuss some research that we are doing at Utah State; and to make a few suggestions about the direction of future research.

Some Problems

Since Keller's (1968) "Goodbye Teacher" article, research in PSI has been almost completely restricted to showing that it is superior to traditional teaching methods in producing better learning (Sheppard and MacDermot, 1970; McMichael and Corey, 1969) and better retention (Cooper and Greiner, 1971). These

three articles did use objective exams to make their comparisons and we do need more research to show that PSI is a better way, especially because of the long history (1924 to 1965) of "no difference" results when different educational techniques have been compared (Dubin and Taveggrio, 1968). Most often, though, researchers have relied upon grade distributions and a heavy dose of student reports to make their case. What's wrong with this? First, verbal reports, while they are suggestive and may provide insight for the teacher, are no substitute for observing what the student does with respect to the material, as all of us operant conditioners are so fond of pointing out to our cognitive brethen. Second, grades are notoriously poor dependent measures of performance especially when the comparison is made across classes. And when we consider that the criteria for attaining an A, B, or F, differ drastically from the PSI class to the lecture class, then it is truly impossible to know what different grade distributions mean.

We continue to engage in these comparisons, I suppose, because it is reinforcing to us to plot distributions and repeatedly come up with more "A"s and "B"s in our classes than "C"s, "D"s, or "F"s. It also looks good to our dean who is always scouting around for "good" instructors and "better" methods of instruction. All those "A"s must mean that you are doing something right, and of course, students do not find anything to criticize in the lopsided distributions either.

Another trend in the current research that creates serious problems of evaluation is that each "pioneer" tends to develop his own version of Keller's basic plan and to discourse at length on the idiosyncratic details of his course to such an extent that even for the "initiates" it is difficult to discover what was done and how. The reader is laden with detail upon detail and when he

finishes the article he finds that the author simply concludes that "my" PSI course was superior to a conventionally taught course. Johnston and Pennypacker (1971), in describing their PSI course, devoted almost one-third (31%) of a long article to procedures. One is left to wonder why all that detail was included, or what there was in the procedures that contributed to the success of the PSI course.

Finally, when one considers the complexity, detail, and hence work involved in setting up a course similar to that espoused by a zealous author, one wonders why the measures of behavior, (learning or interest in the field) remained so gross and subjective. If one is to do all that work, surely he should be convinced that the procedures are related to the outcome and gross measures such as grades are not convincing. Do we really need all those tests and variations of tests, or a ratio of exactly 10 students to 1 proctor, or doomsday contingencies, or required attendance? Is the rate at which a student works important? Do we need to plot individual cumulative records of the student's progress? We will never know until we start treating each of these details as variables and manipulating them in a systematic fashion.

A recent experiment (Stalling, 1971) highlights the dilemma of the would-be adopter of the PSI approach and illustrates the points I have been making. The author's purpose was to demonstrate the effectiveness of an overhead projector in giving and correcting quizzes in a large class and he did. The experimental group scored higher than the control on an objective exam and rated their course higher than did the controls. But these results were achieved in spite of substantial deviations from PSI procedures. Each unit was one chapter in Kendler's text, so the units were much larger than units used in most PSI courses. The course was instructor-paced rather than student-paced. The subjects

could take all three forms of the unit quizzes with only the highest score counting. Thus, mastery of the material was not required. Finally, the course did not use any proctors. So on most of the important characteristics of PSI courses, the procedures differed, yet the results favored the experimental group and the author labeled the course a "programmed course". It is hard to know how to categorize this resaerch. I think it would be unfair and misrepresentative to include it in the body of research supporting PSI as a better method. I do not want to single out this piece of research as being good or bad just that it should not be classified as PSI research. There are significant deviations and/or addenda from Keller's original five points in almost every piece of published research to date. Let's look at some variables that have been modified, added, or left uncontrolled.

Oral Interviews

Ferster (1968) has described one variant of PSI which utilized oral interviews. His report is primarily descriptive but he does advocate, via implication, that the oral interview is worth adopting so I will examine his report as if he had evaluated this innovation. Ferster's major dependent variables are student reports, grade distributions, and the rate of completion of course material. He found that most of his students earned A's and that 36% finished the course three weeks early. The students reported that 1) their verbal fluency and ease in social situations improved; 2) they were able to draw upon their personal experience and relate it to the material in the unit; and 3) their study habits improved in other classes.

Now, with respect to the major independent variable of the study, oral interviews, what can be said? Very little is supplied to the reader which would permit

him to decide for himself whether he should adopt the technique or not. The student reports about verbal fluency and ease in social situations have an obvious face validity but it would be desirable to have independent support for this finding. The report about students' improved study skills generalizing to other classes is potentially a very important finding and deserves experimental substantiation. From the data supplied, it is difficult to infer what was responsible for the favorable reports or to determine the degree to which the students' verbal behavior corresponded to other performance criteria.

We have tried oral interviews at USU and are currently relying on them as one major component in our introductory course. On the face of it, oral interviews permit rapid feedback, an opportunity to correct misunderstandings in a relatively nonthreatening way (a student proctor corrects another student), and an opportunity to probe when the proctor suspects that the interviewee does not "really" understand the material in question. But it is more difficult to maintain quality control with oral interviews than with written quizzes. Also some proctors are obviously much more interested in and willing to help their charges than others. With a written quiz, the stimulus presented to each student is constant. Obviously, there are advantages and disadvantages to each method. Notice, however, that we have adopted an innovation, oral interviews, without evidence of its superiority over the original method. I confess to the same unsystematic tinkering that I am now condemning. As far as I know, there has been no critical study comparing the oral to the written quiz (but see Winkel, 1971).

Self-pacing

Ferster presents individual cumulative records of interviews taken and these data show that students work at different rates. The modal student produced a

"scalloped" performance much like what we have come to expect when traditional methods of instruction are used. This finding contradicts data reported by Lloyd and Knudsen (1969) who found that once a student started working, he worked at a constant and high rate (the break and run performance found under fixed ratio schedules). In Lloyd et al's study, good students, those who end up with A's, started to work earlier than mediocre and poor students. Since, "poor" students do not complete as much work as good students, they earn a lower grade.

We have tried "doomsday" contingencies to get the sluggards going and this has generated a "scalloped" performance in most students. We are no using an adjusting schedule which gives more points the earlier the work is done. This schedule has proved much more effective in getting students started and it also eliminates the scalloped performance (Cheney and Powers, 1971). Since in most PSI courses there are contingencies piled upon contingencies, it is difficult to account for any given pattern of taking exams. It is obviously premature to characterize performance under PSI contingencies (whatever these are) as one way or another.

Beyond the confusion over the pattern of responding, there is the finding that some students finish the course early. For example, during the fall quarter of 1971, we used the adjusting point contingency within a self-paced program and 20% of the class finished the course within 7 weeks. Having students finish early is touted as in some way beneficial to the student and as evidence for the superiority of PSI over traditional instruction. There is little knowledge about the relationship between the rate of doing work and the quality of the learning. In fact, rate of work may not be related to learning. Johnston and Pennypacker (1971) compared a group who had to respond at a fixed, high rate of correct responding and a low rate of incorrect responding when taking a test to a group who had no

temporal constraints imposed and found that there was no difference in the quality of the learning. Both groups responded at better than the 90% level on their measure of performance. The authors do not report data on the number of students finishing the course early in each group so it was not known how the quality of learning was related to rate of progress through the course. The question remains: Do those who finish early learn more or retain it longer than those who complete the course in the alloted time? Of course, if they do not, what advantage accrues to the technique of self-pacing? Perhaps the only advantage is motivational -- it is reinforcing to finish early. Certainly, our students seem to think so. To the question, "The best thing about this class was ...", many of our students answer that it was the opportunity to finish early. If this is the primary benefit of self-pacing, then we should be apprised of this fact and should not overworry about an individual's rate of progress. In fact, Greenspoon (PSI Newsletter, June, 1971) reports that at Temple Buell over 50% of the courses are taught on an individual rate basis with no time limitation. The instructor simply notifies the registrar when the student has met the objectives of the course. If the rate of progress does not matter to any learning variable, why bother to record the cumulative rate of interviews taken. If all your students are not finishing your course, you probably are trying to cover too much material but it does not take individual cumulative records to discover this.

Unit Size

A variable which I believe important is the size of the unit. Within PSI courses, it has varied from a chapter in a standard introductory text (Cooper and Greiner, 1971; Stalling, 1972) to a specially written section of two or three pages (Ferster, 1968). This difference in the amount of textual material covered

per unit obviously makes it difficult to compare the results of PSI courses at different schools. This difficulty is further compounded when one discovers that special projects and other tasks are included in the material that defines a unit (Lloyd and Knudsen, 1969; Mertens, 1970; Malott and Svinicki, 1969). One would certainly expect that unit size and difficulty would determine how many students finish the course and what percentage finish early but so far very few reports have concerned themselves with the amount of work required per unit. Burnstein's recent article (1972) is one exception. He continually decreased the amount of material over a four-year period as students uncovered difficult material. It was interesting that although the units generally got "easier", the average final exam performance remained unchanged at about 80%. In fact, none of his several procedural changes produced improved learning to a significant degree. What did change was that the students rated the course more favorably. Students can be made to do work harder, it seems, but they will resent it.

Gray Osborne and I are preparing a text to accompany the PSI course at USU and we have decided on about 5 to 7 pages of textual material per unit. This "bite size", as we call it, was decided arbitrarily with not much empirical support except that we noted that the amount of material in most introductory texts was too long and contained too much information to demand the kind of mastery that a PSI course is built upon. Now, it would seem that a programmed text would be just what is needed in a PSI course but these have problems too. Students frequently complain that these texts are "dull and tedious." These impressions concur with my own and argues against them for inducing excitement and interest in psychology, which is one of our objectives at USU. Again, however, these are subjective judgements and certainly should not be the major criterion by which

the size of the "bite" is fixed. Where is the research that states that 5 to 7 pages of text or 5 to 7 concepts is optimal and is all that should be included in a unit?

A related question concerns the nature and number of questions asked over the unit. Since we attempt to promote application and integration of knowledge, we ask only a few (6 to 10) questions and include one or two "think" questions after each unit. This question format is similar to Ferster and Perrot's (1968). On the other hand, some authors (e.g., Whaley and Malott, 1971) ask numerous, fill-in and true-false questions. In the Whaley and Malott text, for example, some units have more than 100 questions, a truly impossible number if you use oral exams. Again, there is little research to support either approach.

Lectures

One of our objectives in the introductory course is to stimulate interest in psychology. To accomplish this, we have scheduled some lectures by several faculty members on topics which we felt to be provocative and interesting. We were hoping, by using lectures as entertainment, to generate questions about, and interest in, the topic discussed and through generalization to the field of psychology. This has not proved very successful. For a variety of reasons, attendance at these lectures was low. When no contingencies were placed on lecture attendance and it was made clear to the student that the material presented would not help him pass the course material, very few students attended. Of a class of 180 this quarter, from 5 to 18 students have attended when no other contingencies were in effect. There were some who appeared interested and a few asked questions after the lecture was over but there was the usual 3 or 4 who slept through the entire lecture. However, when one point was occasionally

offered for attendance (a very small payoff in our point system), attendance regularly jumped to 40-50. It is difficult to conclude from our experience with lectures that they are "reinforcers" for most students.

Psychology is only one of several courses which the student is taking so he has plenty of opportunity to attend boring lectures in other courses. His experience with these required lectures may condition him to respond to all lectures as aversive events. One should remember that the program one designs for the student in psychology is only a part of the student's program. Until all courses use lectures as vehicles for stimulating interest and retain individuals who are good at oral presentations, lectures will not be reinforcers for most students.

More to the point, if one believes that "interest lectures" are beneficial to students, one should design an experiment to demonstrate this. It is difficult to evaluate the technique in which students have to have so many points or have passed X number of units before they can attend a lecture. Green (1971b) found that the rate of test taking increased just prior to the first lecture in his course and he noted some spontaneous comments from students indicating that they wanted to complete some material so that they could attend. But, as he admitted, there were confounding factors operating and he could not conclude that students would work to attend a lecture. One could require that students do a special unit that was not required for the course in order to attend a lecture. If a student did do the unit, one could rest assured that the reinforcer was the forthcoming lecture and not the completion of required material which may be reinforcing by itself. Alternately, one could charge a number of points for attendance although the big problem here is that an individual has to endanger his grade (depending on the relative

cost lectures) to attend.

Assuming, for the moment, that lectures can be arranged which are interesting and that it can be shown that some students will work or pay to attend, why should we include this reinforcer in our course? It is not because students will learn from lectures. We are down on the lecture method just because students do not learn from it! So we must hope to interest students in the topic of discussion and eventually psychology. If this is our intention, and it seems plausible, we better start measuring whatever effects lectures are having. Is our objective to have students indicate on some measurement scale that they found the lecture interesting? Although such an indication by the students may be reinforcing to the lecturer, I am sure most of us want to accomplish more than this. I suspect that most of us believe that if the student is interested in the field, he will learn more, take more courses in the field and/or adopt the field as a minor or major. If these are what we hope to accomplish by including stimulating lectures in our course, then we must demonstrate these putative effects. This research is not easy. It is difficult to measure the relationship between "lectures and interest" or between "interest" and "use of principles" one, two, or three years later. But there is no other way of knowing whether we are engaging in "superstitious" behavior or not.

To sum up, I think it is fairly obvious to you by now that much of the research to date has been sloppy, and that many procedures have been introduced with only the flimsyest bit of empirical justification. Keller has attempted to caution the users of his system to think more carefully about the consequences of their changes, but his warning has not been taken seriously. He writes,

> "Generally speaking, no change should be introduced within a programmed system without carefully considering its possible effect upon everyone involved. It is not enough to think only

> of the student's welfare; the proctor, the assistant, and the instructor must also be looked after, if their optimal interaction is to be maintained, and if the system itself is to survive. What is meat for one must not be poison for another" (1971, p. 521).

At this point, I would like to concentrate on some ideas about the future directions of PSI research.

Self-management projects

One objective of our course at USU is to try to show students that the principles they have been learning really work. That, I would suppose, is usually why a lab is added to a course. We have tried using animals and special events such as a rat Olympics but there are problems with animal projects. First, with 400 students and two students to a rat, you need 200 rats. This requires more space and more money than we have. Second, there is a large percentage of students that are not very interested in animals or have an active dislike of rats. Third, the majority of students, while they find the animal performances "cute", do not believe that the principles you used to train them have any relevance to human behavior. Finally, animals are messy and I have been in trouble with both janitors and deans because my rats did not respect their carpets.

We are currently using a self-management project which we feel has been successful in teaching students how to apply behavioral principles and in developing the students' interest in the subject matter. The details of this project are described elsewhere (Edwards and Powers, 1971) but the general plan is to have the student keep a 2-week baseline on some self-behavior and then attempt to modify this behavior by applying a consequence. The student keeps daily graphs and summaries and turns in a weekly report which is graded and returned to him. At the end of the quarter, he turns in a complete paper summarizing his attempt to change his behavior.

From our standpoint, the project has been successful: students appear keenly interested in their own behavior and most seem to make a genuine attempt to follow the guidelines we establish for changing their behavior. The comments that students report in their papers is also reinforcing to us. Students say such things as: "I didn't believe I could ever stop biting my nails but I did" or "I am going to continue using these techniques to completely eliminate my bad habit". The general tenor of these comments is that the student did not believe that the techniques would work at the outset but now he or she is convinced that they do and is glad to have been taught "something useful". On a scale from 1 to 10 with 10 being the most interesting feature of the class, the students gave the self-management projects a modal rating of 9.

We have developed an information and attitude survey which we give at the beginning and end of our course. One item asks the student to estimate the probability that he or she will become a psychology major (on a scale from 1 to 10, very unlikely to very likely) if they are not already psychology majors. The first quarter that we introduced the PSI course was difficult for us and confusing to the students and we found that there was shift away from becoming a psychology major. This quarter, the fifth PSI quarter, we found the opposite trend. About 44% of the students shifted in the direction of becoming a psychology major while about 27% shifted away (see table 1). Figure 1 shows the percentage of students who found the PSI course "less", "equally" and "more" interesting and informative than their other classes for the fall quarter of 1970 and again one year later. There is an encouraging shift towards a more favorable assessment by the students. This indicates, perhaps, that we are doing something right and we believe that the self-management projects had much to do with enlivening the course and changing the percentage of students who shifted toward becoming majors.

However, we made too many other changes to be able to conclude this. We are currently trying to design a study which will permit us to assess the effects of the self-management projects but it is still in preliminary stages so I will not go into it.

An Interest library

A special library could be maintained by a department in which books were catalogued in terms of interest and difficulty level. Moving the library or parts of it into the dorm is currently being tried in another institution and Douglas (1971) reports increased student usage of such a library. A psychology library could be arranged so that records would be kept on which students checked out what books. The student "librarian" could evaluate what the student learned quickly and easily by administering a short test and the student could earn some bonus points for extra reading. In this way, an interest profile could be obtained for all students using the library. The amount of reading as well as the rate of use might provide useful indexes of interest created by various PSI techniques. Thus, if one wanted to know to what extent a "motivational" lecture on imprinting piqued students' interest, he could measure the increment in the number of articles checked out in the area of ethology in the first few days after the lecture. The library would have to have many duplications, say 50 to 100 copies of a given article, but its holdings would not need to be extensive. There is also no reason why the unit of material checked out need be a book. In fact, having large numbers of books in long stacks too closely resembles a conventional library and might not engender much usage. The unit checked out could be as small as a one-page magazine article.

It may be countered that what is wanted is a good reader. But we have little

control over how much material is read in a reader unless we require it and then, of course, we have no way of knowing now much of the material, if any, would have been read because the student's interest has been aroused.

Developing a Question-asking repertoire

One of the often-heard comments by educators is that the ability to ask good questions is the mark of a good student, thinker, or scientist. Yet, we pay little attention to generating question-asking in our students. We expect our graduate students to learn to ask insightful and provocative questions by simply sitting in lectures and listening to their professors. Gordon Flammer summarizes the problem succintly,

> "There is time for only a limited number of questions, and these are only by the more aggressive students. What about the students who are afraid they will make themselves look foolish by asking a "dumb" question? So they rationalize that after class they will look up in the text what they didn't understand in the lecture. But these people are in trouble generally and are behind. They don't have time to look up very many questions and so they just add to their already vast supply of cumulative ignorance" (1971, p. 9).

We have begun to collect some data on the asking of questions in a large classroom. For three quarters in 1970-71, my assistant and I wore a wrist counter and counted every oral question or comment made to us by the students. Most of the time, questions were asked during the class period but occasionally questions were asked at other times. We included such mundane questions as, "Will there be a final?" or "Who is my proctor?" so the count was generous. There was many more opportunities to ask questions than in an ordinary course because only one day a week was given to a lecture or demonstration and there were two "instructors" to ask questions of.

Figure 2 shows the number of question asked in the winter quarter, 1971 and

it can be seen that about 35 questions or comments were made a day. There is some tendency for the questions to taper off as the quarter progresses and on a few days (days before written review exams) the number of questions increased. The numbers beside some of the data points indicate the number attending at the beginning of the class. This day was a Monday and was the day on which the lecture or demonstration was scheduled. It appears that there is very little correlation between the number in attendance and the number of questions asked. Figure 3 shows the number of questions asked one of our better proctors and indicates that she received between 10 and 15 questions a day. Point "a" is a day when both the instructors were absent from the class and point "b" was the day just before a big review exam.

We also solicited written questions from our students and varied the number of points given per question. Students could submit any number of questions with the only requirement being that the question had to deal with some aspect of psychology. Figure 4 shows that we received about 20 questions per day when the questions were worth one point and about 5 times that amount when 2 points per question were given. Now, what can be made of this information on question-asking?

When one considers that there were over 200 students registered for the class, one is struck by the fact that not much behavior was generated by our procedures. If we were to assume that each student asked one question a day, either oral or written, we would expect to have about 200 questions per day, and this goal was rarely obtained. Furthermore, one question a day from each student is not very much behavior especially if one intends to shape the asking of good questions.

One inference from this data is that there is more response cost to the

asking of questions, even in private (i.e., written questions), than we had expected. The implication is obvious: the traditional lecture class with a single instructor doing most of the talking leaves no opportunity to shape the asking of questions. Now, if it is true that learning to ask numerous, good, questions leads to more and better learning, then we should start to design programs which shape these skills. The proctor system that characterizes PSI appears especially well-suited for such a program. With a ratio of 10 students to 1 proctor, the task of reinforcing individual students for asking questions would not be too demanding.

Currently, we are engaged in an experiment which will permit us to determine the effects of writing questions on learning. The basic design is an ABA in which during the experimental conditions, students write down questions as they study. A proctor records the students' study time, reads his questions, and gives the student points based on the quality of the questions. Under control conditions, the student does not write questions. Hopefully, this study should tell us the value of asking questions as one studies and whether the "quality" of a question can be specified to the extent that other students can shape "good" questions.

Summary and Conclusion

In summary, PSI is being tried at a very fast pace and much of the PSI research has been poor. As Born (1971) has pointed out, we do not really know what traditional educational techniques do, so research on PSI is made more difficult because one does not know what "baseline" to compare its effects to. When one adds to these difficulties the confusing procedural menus, intentional and unintentional, that are found in the recent literature, one feels like throwing up one's hands.

I have suggested several dependent measures which might prove useful in evaluating various PSI procedures. Thus, an interest library might provide a behavioral measure of interest generated by a course or some part of a course. A related measure of interest might be the number of students who indicate an increased likelihood that they will major or minor in psychology. Of course, this expression of verbal interest should be validated by actual count but this is not a difficult problem. We might attempt to define what constitutes a good student and begin to shape up these requisite skills, although this procedure does not constitute a part of PSI per se. Question-asking seems to be one such skill and there is no reason why a four-year profile might yield much more relevant information than grades or, even, which courses the student took, especially to the potential employer who is seeking a good scientist or problem-solver. The bonus to the researcher is that he might use the number and quality of questions students ask as a dependent measure for an independent variables of his interest.

Other variables, such as the number and pattern of withdrawals in the course, could help us diagnose trouble spots and may uncover hidden assumptions that we are making. Dave Born, at the University of Utah, has found that three times as many students withdrew from his PSI course than from a traditionally taught course and that most of the withdrawals came <u>after</u> the student had passed the last unit. He also found, contrary to what you might expect, that it was the "poor" students who were withdrawing (Born, 1971; Born and Herbert, 1971). These findings are somewhat surprizing and indicate, I think, a failure in our programming. To exchange C's, D's, and F's for withdrawals is not a satisfactory solution for dealing with poor students especially, if those students withdraw with a bad taste in their mouth.

Finally, I believe that many of us would like to think that what we taught in our introductory course had some relatively lasting effect. After all, the course is about behavior, their behavior, and nothing would seem more convincing to the student that to be able to use the information he learned in class to bring about a change in his life. So if we would like to claim that some technique such as oral interviews or a lab project helped the student learn to study, we should measure study skills for students who receive such treatment and those who do not. This seems too obvious to have to say but, unfortunately, these simple comparisons have rarely been made. Fred Keller has given us an exciting and effective way to help students learn. The PSI approach deserves better treatment than it has been getting at the hands of its friends.

Table 1

Number of students indicating change in probability of becoming a Psychology major after taking PSI course, Fall Quarter, 1971.

	Change away from becoming Psychology Major	No change	Change toward becoming Psychology Major	Total
N	43*	53	77*	173
%	25	31	44	100

*P $\angle$ .01; Sign test

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